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REPORT NO. 527

ACOUSTIC REFLEX RESPONSE TO HIGH INTENSITIES OF IMPULSE NOISE AND TO NOISE AND CLICK STIMULI

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UNITED STATES ARMY

MEDICAL RESEARCH AND DEVELOPMENT COMMAND 22 December 1961

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Report Submitted 12 December 1961

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REPORT NO. 527

ACOUSTIC REFLEX RESPONSE TO HIGH INTENSITIES OF IMPULSE NOISE AND TO NOISE AND CLICK STIMULI

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Psychology Division
US ARMY MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

22 December 1961

Audition and Auditory Perception in Relation to Performance
Task 02
Psychophysiological Studies
USAMRL Project No. 6X95-25-001

Report No. 527
USAMRL Project No. 6X95-25-001-02

ABSTRACT

ACOUSTIC REFLEX RESPONSE TO HIGH INTENSITIES OF IMPULSE NOISE AND TO NOISE AND CLICK STIMULI

OBJECT

To evaluate acoustic reflex (AR) response to high intensity impulse noise and to determine the relative effectiveness of clicks and noise AR eliciting stimuli at two different sensation levels (SL).

RESULTS

The AR was found to operate at high intensity levels in a manner similar to that observed previously at lower levels. No difference in effectiveness was noted between clicks and noise as AR eliciting stimuli, nor was any difference found between the two SLs of the stimuli that were studied. The only significance in main effects was that between the AR and no AR conditions.

CONCLUSIONS

The AR operates in essentially the same manner at high as at low SPLs. For the exposure used, there is apparently no difference in the click and noise AR eliciting stimuli nor in different SLs of stimuli. It is believed that more exposure might have enabled better discrimination of the relative effectiveness of such stimuli.

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ACOUSTIC REFLEX RESPONSE TO HIGH INTENSITIES OF IMPULSE NOISE AND TO NOISE AND CLICK STIMULI

I. INTRODUCTION

Previous research regarding the protective aspects of acoustic reflex (AR) action has been primarily concerned with moderate levels of impulse stimuli (1, 2). It is possible that AR action could be different at levels higher than the moderate levels used in previous experiments. It is suggested by Békésy (3, pg. 97) and Møller (4) that the ossicular chain vibrational mode changes with intensity, at least for low frequency stimuli. Therefore, the higher sound pressure levels might rotate the ossicular chain out of its usual mode of operation, thereby changing the effect of the tensor tympani and stapedius contractions upon the transmission of sound to the inner ear. Similarly, at higher levels of stimulation the AR might possibly respond differently to reflex eliciting stimuli than it does at lower levels.

II. METHOD

In order to test the above possibilities, the following experiment was designed; each subject was exposed five times to 160 and 170 db sound pressure level (SPL) impulse noise. In one session at each intensity there was no AR protection, in a second there was a train of clicks at 105 db sensation level (SL) or 120 db SL switched on 150 msec prior to each impulse to elicit the AR and in the third a noise stimulus at 105 or 120 db SL was similarly presented before the impulse to arouse the AR.

The high intensity impulse signal was generated by a device called the photoformer (5). This experimentally developed device permits the precise generation and replication, at almost any desired rate, of impulse sounds that can be precisely controlled for rise time, duration, intensity, and spectrum. A block diagram of the equipment used in this experiment is presented in Figure 1.

The click stimuli were generated by a Tektronix Pulse Generator, Model 16. Pre- and post-exposure audiograms were obtained using a Grason-Stadler Model E-800 Audiometer. In addition, the masking output of the audiometer was used as the noise stimulus. The impulse stimuli were programmed by a Gerbrands Tape Programmer and presented at a rate of 40 impulses per minute. The transducer used was the same one used by Ball (5).

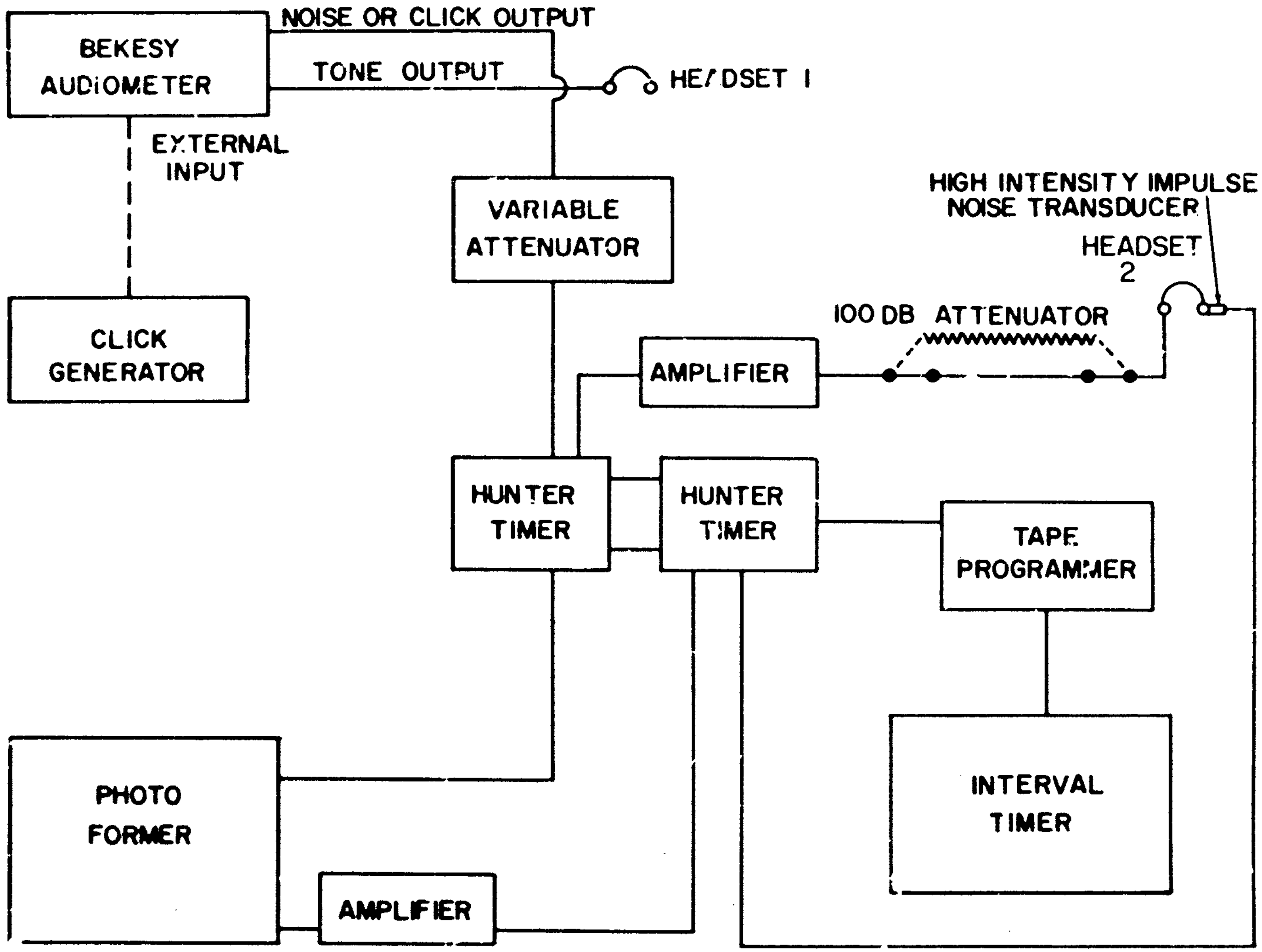

Fig. 1. Block diagram of the apparatus.

Thresholds for the noise and click were determined for each subject and a reference voltage across the earphone noted, then 105 or 120 db attenuation was removed from the system to reflect the proper SL.

Each subject was given sufficient training in the use of the Békésy technique of audiometry to assure reliable thresholds prior to collection of any data. Upon completion of training in the use of the Békésy, the subjects were exposed (no more than once per day) for increasingly longer periods of time to 170 db, then 160 db SPL impulses until a measurable temporary threshold shift (TTS) had been induced. Thus, a control (no AR) condition duration was arrived at slowly in order to avoid inducing any permanent threshold shifts.

Once the exposure time for a given level of stimulation was determined, the subject was exposed to the other four experimental conditions at two different SPLs in a counterbalanced order.

All testing was conducted in a sound treated room with an ambient sound level of about 45 db. In a typical experimental session a sweep frequency pre-exposure Békésy audiogram (3000 - 8000 cps) was taken. The headset was then removed and the special transducer used for the high intensity impulse signals was placed on the subject's head. The proper SPL was set for the reflex eliciting sound, the appropriate duration of exposure was set on the timer, and the exposure was begun. As soon as the timer terminated the exposure, the impulse noise transducer was removed, the Békésy headset put on, and the post-exposure threshold taken. Elapsed time from termination of exposure to beginning of threshold testing averaged about 10 sec. The pre- and post-exposure thresholds were then compared to determine the effects of exposure to the given experimental condition.

Of the 15 subjects used in this experiment, 13 were Tufts University students or staff, two were USAMRL staff members. There were nine females and six males, with ages from 17 to 36. There was no screening for hearing deficit. No subject was exposed more than once per day.

Duration of exposure varied from subject to subject, i.e., some subjects required longer unprotected exposure to the impulse noise to induce a measurable TTS than did others. Additional exposure was not given if the subject had a TTS of 5 db or more. The actual exposure times ranged from 18 - 35 min.

III. RESULTS

The raw data (TTS differences between the various experimental conditions) were submitted to a complex analysis of variance. This was for two intensities (170 and 160 db SPL), five experimental conditions (no AR, and 105 and 120 db SPL reflex eliciting click and noise stimuli), five test frequencies (3000, 4000, 5000, 6000, and 8000 cps), and 15 subjects.

Results of the analysis are shown in Table 1. Of the main effects, Conditions and Subjects were the only ones to achieve statistical significance, and of those two we are really concerned only with Conditions.

TABLE 1

Analysis of Variance of the Intensities by Conditions x Frequencies x Subjects' Data (2 x 5 x 5 x 15)

Intensities (I)	1	745.87	NS
Conditions (C)	4	3502.09	14.95**
Frequencies (F)	4	24.80	NS
Subjects (S)	14	1135.27	8.78
I x C	4	185.87	NS
I x F	4	35.80	NS
I x S	14	209.26	NS
C x F	16	44.67	NS
C x S	56	196.94	NS
F x S	56	129.32	2.48**
I x C x F	16	43.87	NS
I x C x S	56	234.22	8.41**
I x F x S	56	52.18	1.87*
C x F x S	224	32.22	NS
I x C x F x S	224	27.84	

* Significant at the 5% level of confidence.

**Significant at the 1% level of confidence.

All other significant terms were interactions involving subjects. The means for the five different experimental conditions are presented in Table 2. The effects of Conditions were further broken down to their individual means and the difference between the means of the five conditions were tested for significance. Only the difference between the

TABLE 2

Means (in db TTS) for the Five Experimental Conditions

Control (no AR)	105 db SL Click	120 db SL Click	105 db SL Noise	120 db SL Noise
13.47	4.41	1.37	4.20	2.25

control and each of the experimental conditions were significant ($P < .01$). The differences observed were all in the expected direction, i.e., there was more TTS in the control condition where no AR protection was present than in any of the other four conditions where either click or noise stimuli at 105 or 120 db SL were presented. This also suggests that the click and noise AR stimuli did not differ significantly in the protection afforded in this experiment. Another possibility is that both stimuli are effective enough to give almost complete protection and that possibly the only way to differentiate between the two would be to pose a more challenging problem, i.e., present much more stimulation. A third possibility is that the trends (which were not significant) for the 120 db SL stimulus to result in smaller TTS than the 105 db SL stimulus, and for the clicks is to give more protection (result in smaller TTS) than noise, would have been significant with a few more subjects. It is also possible that the earlier differences obtained are due to differential adaptation for noise and clicks and that in a brief interval after reflex activation the effects of the two are the same. However, the question cannot now be resolved. The other significant terms in the analysis are perhaps of interest but not of any real import.

IV. DISCUSSION

These results have shown that, even if high intensity impulse noise changes the mode of operation of the ossicular chain (and it is by no means certain that it does), the acoustic reflex contraction still displays its usual protective effect.

Results also indicate that, even though past research (6) has shown that click stimuli are more effective in arousing AR action, they do not necessarily protect persons exposed to impulse noise significantly better than noise stimuli. However, it is possible that the extreme care taken to avoid incurring permanent threshold shifts in

the subjects used in this experiment could have resulted in the situation failing to provide an adequate test of the difference in protective effects of noise and click AR eliciting stimuli.

V. REFERENCES

1. Fletcher, John L. and A. J. Riopelle. Protective effect of acoustic reflex for impulsive noise. J. Acoust. Soc. Amer. 32: 401, 1960.

2. Ward, W. Dixon, W. Selters and A. Glorig. Exploratory studies on temporary threshold shift from impulses. J. Acoust. Soc. Amer. 33: 781, 1961.

3. von Békésy, Georg. Experiments in Hearing. McGraw-Hill, New York, 1960, 745 pp.

4. Møller, Aage. Bilateral contraction of the tympanic muscles in man. Report No. 18, The Speech Transmission Lab, The Royal Institute of Technology, Stockholm, Sweden, 20 Feb 1961.

5. Ball, Jay. Instrumentation for a study of temporary threshold shifts caused by high-intensity acoustic transients. Report No. 785, Bolt, Beranek and Newman, Inc., Jan 1961.

6. Fletcher, John L. and M. Loeb. Contralateral threshold shift and reduction in temporary threshold shift as indices of acoustic reflex action. USAMRL Report No. 490, Ft. Knox, Ky., Aug 1961.

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Report No. 527, 22 Dec 61, 6 pp & ii - 1 illus-2 tables - Project No. 6X95-25-001, Unclassified Report

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2. Acoustic Reflex
3. Psychology

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